Japanese Unexamined Patent Publication No. 143556/2003 (*Tokukai* 2003-143556)

A. Relevance of the Above-identified Document

The following is a partial English translation of exemplary portions of non-English language information that may be relevant to the issue of patentability of the claims of the present application.

B. Translation of the Relevant Passages of the Document

See also the attached English Abstract.

[0053] Fig. 19 is a diagram illustrating a configuration of a control circuit for performing I-P conversion and overdrive, from which circuit the frame memory3 1702 and frame memory4 1703 are reduced.

[0054] In Fig. 19, the reference numeral 1901 indicates a data processing section for receiving comparison data between adjacent frames, and for performing I-P conversion and over drive. The reference numeral 1902 indicates a correction value calculating section which calculates, during the overdrive, a correction value for output data by using a comparison result obtained from the movement detection control section 607. The reference numeral 1903 indicates an overdrive correction data generating section which receives (i) non-interlace video signal output from the I-P

conversion circuit 608, and (ii) the correction value output from the correction value calculating section 1902, and which outputs an overdriven signal.

[0055] The detection result from the movement detection control section 607 is the same as that of Fig. 6, and is input to the I-P conversion circuit 608 as well as to the correction value calculating section 1902.

[0056] Fig. 20 shows an operation flowchart for the foregoing Embodiment 3 of the present invention, illustrated in Fig. 19.

[0057] The flowchart indicates processes from start to the end which are performed with respect to a single pixel, and the flow is repeated for each pixels.

[0058] First, respective data pieces in the same field of adjacent frames are compared through a movement detection operation. In each of these data pieces in the same field, odd and even lines switches every frame. Next, detection data obtained from the movement detection operation, and a threshold serving as a criterion for judging a movement are compared with each other, thereby to judge whether or not a movement exist between the frames. Here, the detection data is a difference in data of one frame and another frame. As such, if this difference is smaller than the threshold value, it is judged that no movement exists. Therefore, an inter-field interpolation is performed in the I-P conversion section, and processes for

a single pixel are completed. On the contrary, if the difference between the frames are larger than the threshold value, it is judged that there is a movement, in which case inner-field process is performed in the I-P conversion section, and non-interlace video signal is generated. This video signal is output to an overdrive section, and an overdrive correction value calculation process corresponding to the difference in the data of the frames is performed. Then, video data to which the resulting correction data is added is generated. This video data is output as display data, and processes for a single pixel is completed.

[0059] Fig. 21 is a schematic diagram illustrating an operation of Embodiment 3 in accordance with the present invention. In Fig. 21 shown is an example where the master field is an odd field of an (N+1) frame.

[0060] The first line of I-P converted data is the first line 1(2) of an odd field of the (N+1) frame, which field is a master field. The data of this line is output as it is as display data, because no data resulted from comparison of frames is not available. Next, for the second line of the I-P converted data, the first line 2(1) of even field data of the (N) frame is compared with the first line 2(2) of even field data of the (N+1) frame. In the present example, it is judged that there is no movement. Therefore, the first line 2(2) of the even field data of the (N+1) frame is output as

the second line of the I-P converted data (inter-field interpolation). Furthermore, since it is judged that there is no movement, correction by overdriving is not necessary, and the first line 2(2) of the even field of the (N+1) frame is output as it is as display data. Next, for the third line, the second line 3(2) of the odd field of the (N+1) frame is output as in the case of the first line. Next, for the fourth line, the second line 4(1) of the even field data of the (N) frame is compared with the second line 4(2) of the even field data of the (N+1) frame. In the present example, it is judged that there is a movement. Therefore, the second line of the odd field data of the (N+1) frame is output as the fourth line of the I-P converted data (inner-field interpolation by line doubler). Furthermore, since it is judged that there is a movement, a correction value α is found out in the overdrive section, based on the amount of the movement. Then, data to which the value α is added (i.e. 3(2) + α), is output as display data. By performing the above described processes, it is made possible to share the movement detection section, and to overdrive both I-P conversion and even lines of display data.

[0061] Fig. 22 is a schematic diagram illustrating an operation in relation to a frame whose master field is the odd field of the (N+1) frame, and which frame is subsequent to the frame of Fig. 21 whose master field is the odd field of the (N+1) frame shown in Fig. 21. The

operation is essentially the same as the operation performed for the case of Fig. 21 in which the odd field of the (N+1) frame is the master field. In this example, the comparison targets are odd field data of the (N+1) frame, and odd field data of an (N+2) frame. In regard to display data, overdriving of odd lines is enabled.

[0062] In other words, the overdrive for the display data is alternately performed with respect to the odd lines and the even lines, as illustrated in Figs. 21 and 22.

[0063] Fig. 23 is an example of overdrive controlling algorithm of the present invention.

[0064] In Fig. 23, output display data having been corrected is found from input video data ND of the current frame and one-frame preceding input video data OD, by using the following relational expression.

[0065]

Output display data = ND + $\alpha \times$ (ND-OD)

More specifically, a difference (ND-OD) in the video data sets of adjacent frames, is multiplied by the correction value α. Then, the input video data ND of the current frame is further added. Here, the performance is largely influenced by the value α. In the case of Fig. 23, the response characteristic of liquid crystal varies when the α = a, α = b, α = c, and α = d, where: a is the characteristic resulted when the correction value is substantially zero; b is the characteristic resulted when

the speed is put more weight; c is the characteristic resulted when the luminance is compensated; and d is the characteristic resulted when the luminance is further emphasized. The calculation method of these α is obtained by combining grayscale data matrixes of the input video data ND of the current frame and the one-frame preceding video data OD, and by observing response waveforms. Further, since the characteristics of the liquid crystal in relation to (i) rising from a low grayscale level to a high grayscale level and (ii) falling from a high grayscale level to a low grayscale level are different, two correction values α (one for rising and another for falling) are calculated on the boarder of a point at which the input video data ND of the current frame and the one-frame preceding input video data OD are equal (See the matrix of Fig. 23).

[0066] If the luminance is excessively emphasized as in the case where $\alpha = d$ (See Fig. 23), the contrast is emphasized and well defined video image is obtained. However, a problem stemming from γ property of the liquid crystal panel may take a place.

[FIG. 19]

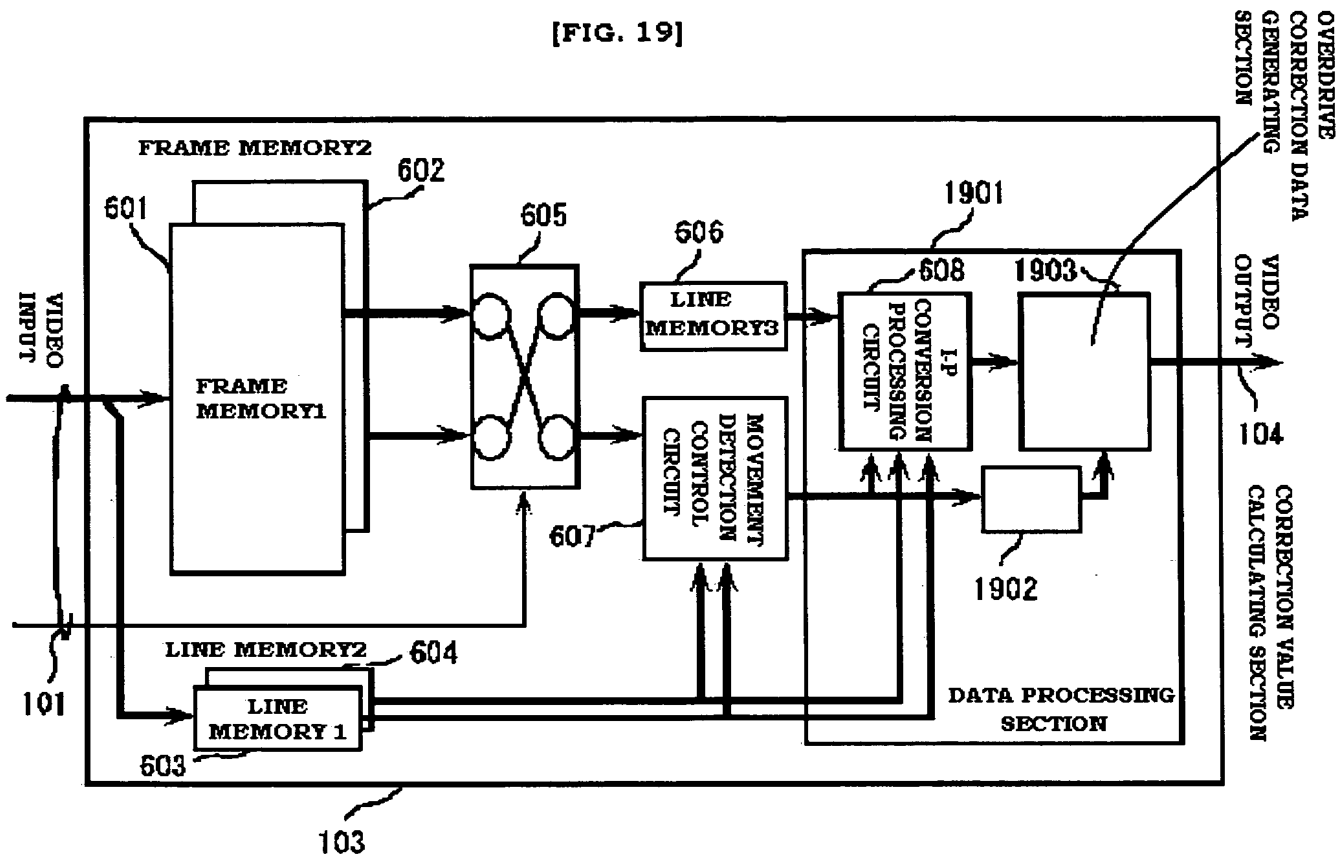

FRAME MEMORY2
602
601
605
606
1901
LINE MEMORY3
608
1903
OVERDRIVE CORRECTION DATA GENERATING SECTION
VIDEO INPUT
FRAME MEMORY1
I-P CONVERSION PROCESSING CIRCUIT
VIDEO OUTPUT
104
MOVEMENT DETECTION CONTROL CIRCUIT
607
1902
CORRECTION VALUE CALCULATING SECTION
LINE MEMORY2
604
101
LINE MEMORY 1
DATA PROCESSING SECTION
603
103

FIG. 20

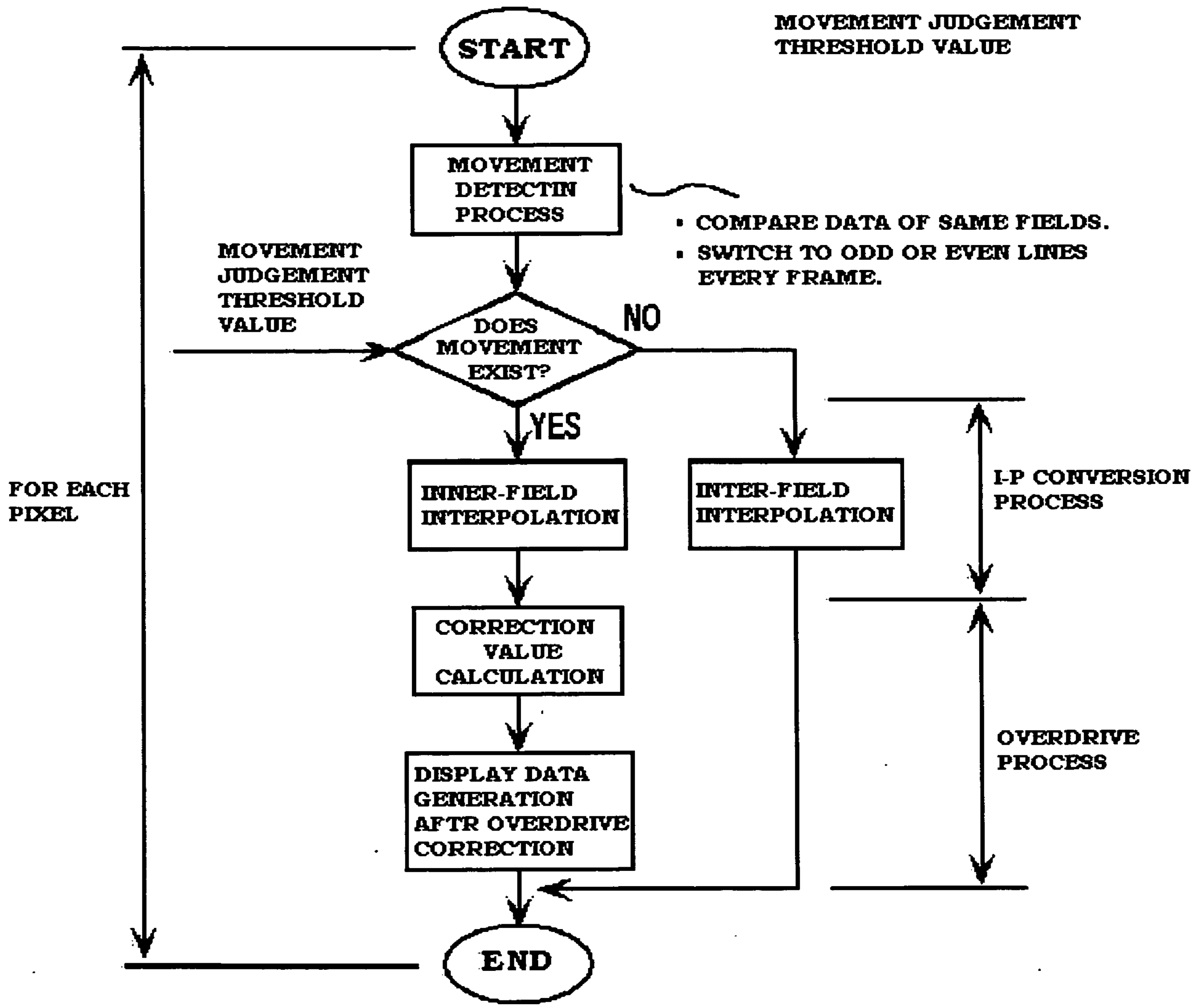

MOVEMENT JUDGEMENT THRESHOLD VALUE
START
MOVEMENT DETECTIN PROCESS
• COMPARE DATA OF SAME FIELDS.
• SWITCH TO ODD OR EVEN LINES EVERY FRAME.
MOVEMENT JUDGEMENT THRESHOLD VALUE
DOES MOVEMENT EXIST?
NO
YES
FOR EACH PIXEL
INNER-FIELD INTERPOLATION
INTER-FIELD INTERPOLATION
I-P CONVERSION PROCESS
CORRECTION VALUE CALCULATION
OVERDRIVE PROCESS
DISPLAY DATA GENERATION AFTR OVERDRIVE CORRECTION
END

FIG. 21

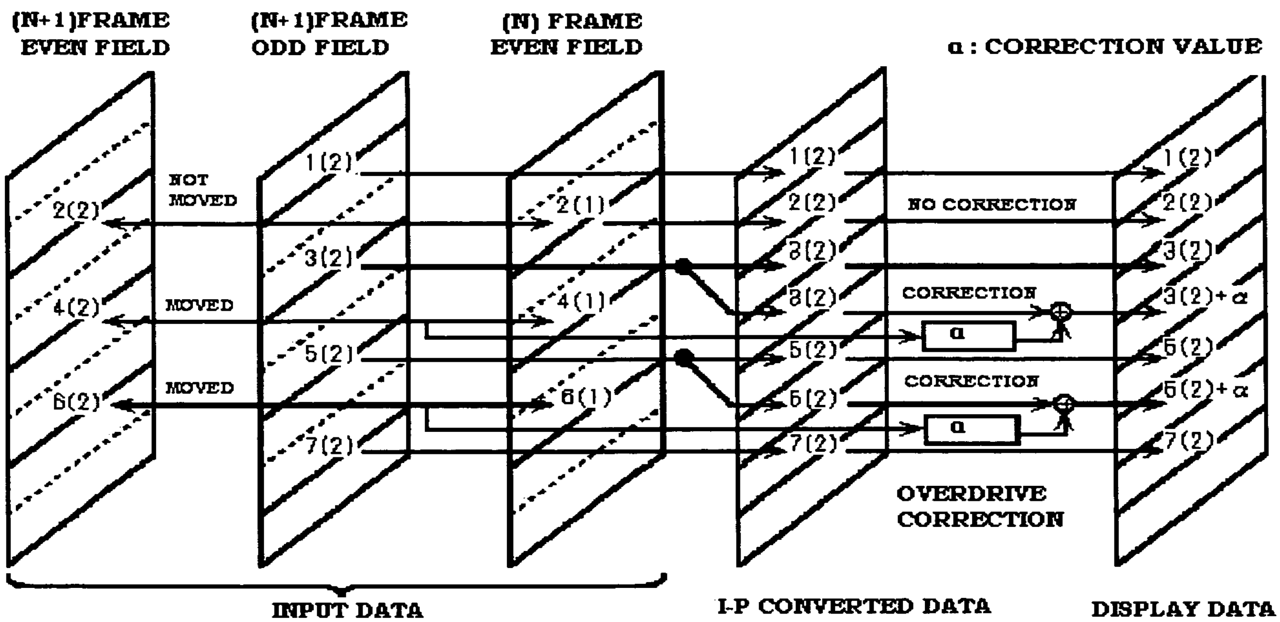

(N+1)FRAME EVEN FIELD
(N+1)FRAME ODD FIELD
(N) FRAME EVEN FIELD
α : CORRECTION VALUE
NOT MOVED
MOVED
MOVED
1(2)
2(2)
3(2)
4(2)
5(2)
6(2)
7(2)
2(1)
4(1)
6(1)
NO CORRECTION
CORRECTION
CORRECTION
α
α
3(2)+α
5(2)+α
OVERDRIVE CORRECTION
INPUT DATA
I-P CONVERTED DATA
DISPLAY DATA

FIG. 22

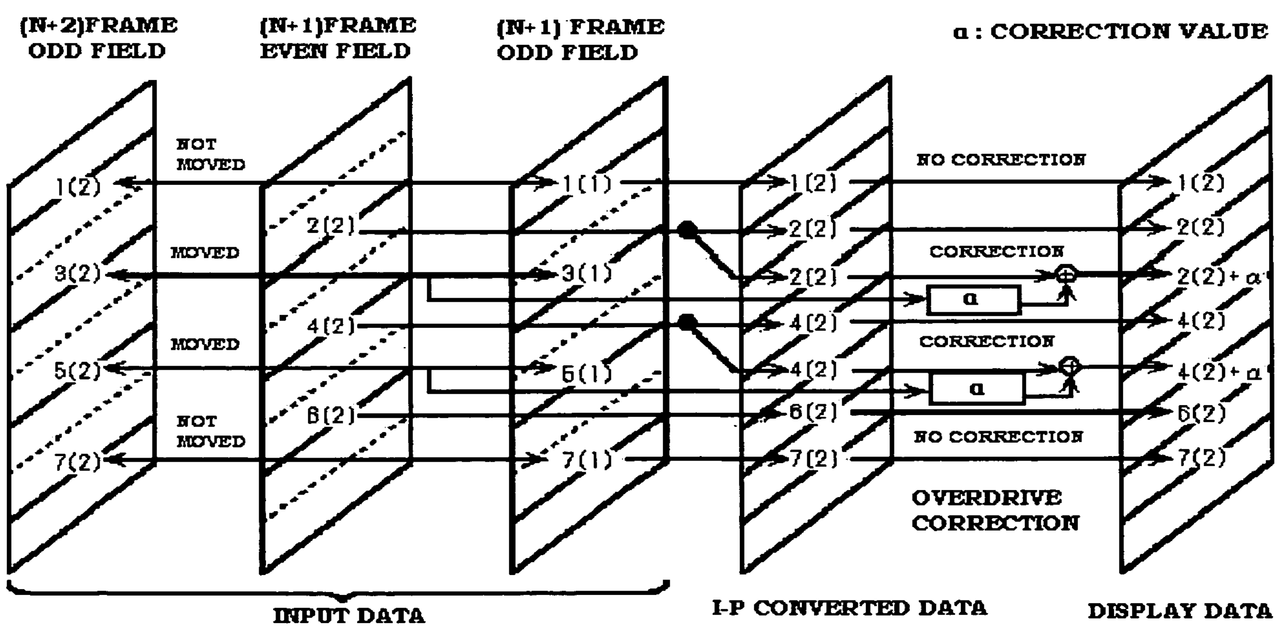
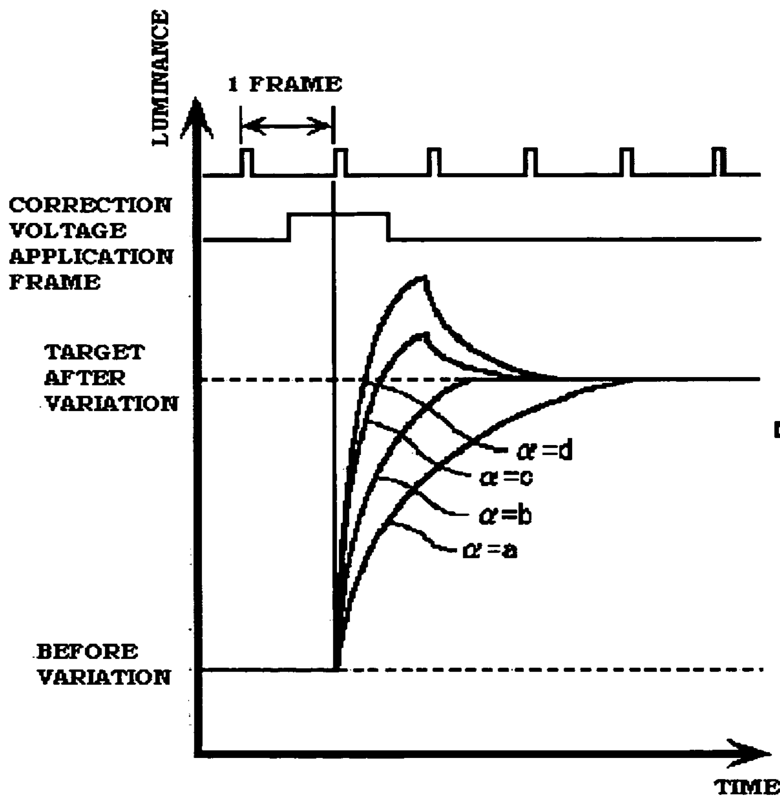

(N+2)FRAME ODD FIELD
(N+1)FRAME EVEN FIELD
(N+1) FRAME ODD FIELD
α : CORRECTION VALUE
NOT MOVED
MOVED
MOVED
NOT MOVED
1(2)
3(2)
5(2)
7(2)
2(2)
4(2)
6(2)
1(1)
3(1)
5(1)
7(1)
NO CORRECTION
CORRECTION
CORRECTION
NO CORRECTION
α
α
2(2)+α
4(2)+α
OVERDRIVE CORRECTION
INPUT DATA
I-P CONVERTED DATA
DISPLAY DATA

FIG. 23



OUTPUT DATA $=ND+\alpha\ (ND-OD)$

CURRENT FRAME DATA ND

PRECEDING FRAM DATA OD

	00	07	15	23	31	39	47	55	63
00	00								
07		00							
15			00						
23				00		RISING			
31					00				
39				FALLING		00			
47							00		
55								00	
63									00